

ROBBER FLY AND TROUT PREDATION ON ADULT DRAGONFLIES (ANISOPTERA: AESHNIDAE) AND FIRST RECORDS OF *AESHNA UMBROSA* FROM WYOMING¹

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ABSTRACT: Two instances of predation on large adult dragonflies (Anisoptera: Aeshnidae) are recorded from the foothills of the Big Horn Mountains in north-central Wyoming. A medium sized robber fly, *Stenopogon inquinatus* (Asilidae), was photographed and captured while taking a male *Aeshna umbrosa*. The dramatic size differential between the robber fly predator and its larger aeshnid prey is unusual. This note includes the first published records of *A. umbrosa* from Wyoming, as well as the first record of *S. inquinatus* capturing an aeshnid. Also, a male *Aeshna eremita*, and a female *Aeshna* sp. were recovered among the stomach contents of two brook trout, *Salvelinus fontinalis*, taken in the same general area.

Adult aeshnid dragonflies are usually considered top aerial insect predators. They are, in turn, occasionally preyed on by other upper-level consumers. Dunkle & Bellwood (1982) reported bats as odonate predators. McCafferty (1981) listed frogs and birds, and Howard (1905) kingbirds, as predators of adult Odonata. Wright (1946) and Belle (1994) referred to human consumption of adult odonates. In more comprehensive listings, Wilson (1917-1918), Garman (1927), McAtee (1932), Laroche (1976; 1978), and Westfall (1984) included fishes, amphibians, turtles, birds, spiders, tiger beetles, ants, wasps, and other dragonflies as predatory on adult odonates. Even horses are known to be an indirect cause of mortality in Anisoptera by inadvertently consuming and trampling emerging naiads, while grazing around ponds (Thompson *et al.* 1985).

There are relatively few records of asilids preying on adult Odonata (Poulton 1906; Lavigne 1976). Hobby (1935) observed that robber flies were not important predators of adult odonates, because most asilids occur in much drier habitats than do many dragonflies and damselflies. Borrer *et al.* (1976) listed dragonflies as prey of robber flies. Breland (1942) and Corbet (1962) gave several references of asilid predation on adult odonates. Furthermore, Corbet (*loc. cit.*) stated that asilids are probably some of the most frequent predators of perched dragonflies but added that such perching insects are well concealed by

¹ Received March 24, 1995. Accepted May 19, 1995.

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their postures, cryptic coloration, and choices of resting sites. However, few others writing about dragonfly biology include the Asilidae among adult dragonfly predators.

Although fish are well-known predators of larval Odonata (Wright 1943; Morin 1984; Fong 1985; Heads 1985), there is little published evidence that they prey on adults. Neither Needham (1969) nor Westfall (1984) include them in their lists. However, Wilson (1917-1918) and Garman (1927) observed that adult odonates are taken by fish, and Valley (1993) recently noted that many rainbow trout in Grande Ronde Lake in the Elkhorn Mountains of Oregon feed principally on adult dragonflies, including *Somatochlora* and *Aeshna* spp. (see below). This paper reports two observations in which large adult aeshnids have become prey for other top-level insectivores while the insects were either active or were perching in the natural environment. In one case the predator was a smaller robber fly; in the other, two adult dragonflies were found among the stomach contents of two brook trout, both caught in August.

These observations were made in north-central Wyoming on the South Fork of Rock Creek approximately 2 km SW of Saddlestring (Johnson Co.) [lat. 44° 27'N; long. 106° 54'W; elev. 1739 m; 10 km UTM Zone 13T grid square: CV 30]. This area is a typical dry sagebrush habitat located in the foothills of the Big Horn Mountains. The stream width varies from 6-18 m, and the depth from 0.15-1.8 m at this time of year.

OBSERVATIONS AND DISCUSSION

Predation by Robber Fly. On 12 August 1979, A. P. P. was hiking along a riding trail beside the creek at 10:30 a.m. MDT. The weather was seasonably sunny and cool. His attention was attracted to a loud buzzing noise coming from several feet in front of him on the horse trail. Investigation revealed that a medium-sized, female robber fly, *Stenopogon inquinatus* (Loew), had caught and pierced the dorsal thorax of a large male shadow darter, *Aeshna umbrosa* (Walker), with its proboscis. The buzzing sound was made by the dragonfly's wings as it attempted to escape. Both insects were in worn condition, and seemed to have been on the wing for several weeks.

The two insects remained on the trail long enough to be photographed (Fig. 1) before being collected with a hand-net. The size difference between the dipteran predator and its aeshnid prey is noteworthy; the dragonfly is approximately three times larger than the robber fly (Table 1). The specimens have been placed in the insect collection, Department of Biological Sciences at UMBC.

R. Lavigne, Dept. of Plant, Soils, and Insect Sciences (P.S.I.S.), Univ. of Wyoming (pers. comm.) reports that the entomology collection in the Rocky Mountain Systematic Entomology Laboratory contains one other specimen of *A. umbrosa*, collected near Laramie on July 26, 1937, and identified by D. R.

Molnar. Also, O. Flint of the U.S.N.M.N.H., Smithsonian Institution, Wash., D.C. (pers. comm.) reports that the odonate collection there contains no *A. umbrosa* from Wyoming. Neither Williamson (1900), Molnar (1977), nor Molnar and Lavigne (1979) include this species in their discussions of Wyoming dragonflies. As far as we can ascertain, these two specimens represent the first published records of this dragonfly species from Wyoming.

Lavigne (1976; pers. comm.) recorded 20 species (including three families and 14 genera) of Anisoptera, along with 15 species (including three families and nine genera) of Zygoptera as prey of asilids. He noted that these records involve 53 species of robber flies. Among these, 24 species of asilids (representing 14 genera) attacked anisopterans, whereas 29 species (in 19 genera) captured zygopterans. This thorough review contains many single incidents, but also involves multiple occurrences between the same predator and prey species (up to 43 times for one central European species pair). In several cases, adult aeshnids, gomphids, and libellulids even caught asilids, as well! Bullington (1978), likewise, contributed several additional records of asilids preying on adult dragonflies (see also Table 1). Altogether, Lavigne (1976) and Bullington (1978) documented 38 species of odonates as prey of 56 different species of asilids.

For aeshnids (and gomphids), Lavigne's (1976) review includes the following predation records (listed chronologically, by genera):

1) *Aeshna grandis* (L.), taken by *Satanas gigas* Eversm. in Kiev Province, Russia (Federov, 1925).

Table 1. Body length (BL) and Wing length (WL-tip to mid-line) measurements (mm) and ratios of various robber fly predators and their odonate prey.

Diptera: (Asilidae)			Odonata: (Families as listed)			(Predator/Prey ratios)	
Species	BL	WL	Species	BL	WL	BL	WL
1) ¹ <i>Promachus rufipes</i> Fabr.	33	24	<i>Pachydiplax longipennis</i> Burmeister (Libellulidae) ♂	38	35	0.87	0.69
2) ¹ <i>Efferia aestuans</i> L.	22	15	<i>Ischnura posita</i> Hagen (Coenagrionidae) ♀	27	16	0.81	0.94
3) ² <i>Stenopogon inquatus</i> Loew	24	19	<i>Aeshna umbrosa</i> Walker (Aeshnidae) ♂	65	46	0.37	0.41

¹Data modified from Bullington (1978)

²Data from this study.

2) *A. tuberculata* (Walker), caught by *Proctacanthus milbertii* (Macquart), in Michigan (Bromley, 1949).

3) *Anax* sp. killed by *Eccoctopus longitarsis* (Macquart), in Egypt (Efflatoun Bey, 1934).

4) *Caliaeshna* sp., preyed upon by *Trichomachismus paludicola* (Lehr) in Kocakhstan, U.S.S.R., [with the dragonflies caught while flying, and accounting for 24.1% of its prey, with some individuals being up to six times longer than the fly itself (Lehr, 1967)], and

5) *Gomphus* sp. female, caught by *Proctacanthus longus* (Weidemann), in Texas (Bromley, 1934).

Predation by Brook Trout. A. P. P. has, for the past 24 years, collected and preserved the viscera of three species of trout [brook trout, *Salvelinus fontinalis* (Mitchell); brown trout, *Salmo trutta* (L.); and rainbow trout, *Oncorhynchus mykiss* (Walbaum)] taken from this region while dry fly fishing during late July and August (1968-1992). The viscera of between 20 and 80 fish have been collected annually. All fish were caught in the North or South Forks of Rock Creek. The trout stomach contents have been used to make ecological comparisons of the feeding habits and niche dimensions of the three trout species which compete as top carnivores in the stream both inter- and intraspecifically.

Among the samples were two large brook trout, one female and one male (estimated lengths 25-36 cm), taken from the South Fork of Rock Creek in August, 1978. Among the stomach contents of the female trout was a male lake darner, *Aeshna eremita* (Scudder). The condition of the dragonfly indicated that it had only recently been eaten and that it likely was alive and active when taken by the fish. *Aeshna eremita* is listed as a Wyoming species by Bick & Hornuff (1972), Molnar (1977), and Molnar & Lavigne (1979); it has not been reported from Johnson County. A second specimen (female) of *Aeshna* sp. was found among the stomach contents of the male trout. The partially digested condition of this insect prevented positive specific identification, although possible species include: 1) *A. umbrosa*; 2) *A. eremita*; 3) the darner paddle-tail, *A. palmata* (Hagen); and 4) the variable darner, *A. interrupta interna* (Walker). R. L. Orr (pers. comm.) of the USDA, who identified the specimen, noted that her abdominal appendages (paddles) are elevated at a 90° angle to her abdomen, as if she had been ovipositing when taken by the trout. Both aeshnids were of standard size for their species, wing lengths: *A. eremita* = 41 mm; *Aeshna* sp. = 45 mm, and body-lengths: *A. eremita* = 54 mm; *Aeshna* sp. = 55 mm. These are rather large insects to be taken by trout of these sizes, although some Orthoptera eaten by these trout also approach this size.

Over the years, the trout stomach contents reveal that some fish are generalists, *i.e.* non-selective feeders, whereas others specialize on particular kinds of



Fig. 1 — A. Dorsal view of the robber fly *Stenopogon inquinatus* attacking the dragonfly *Aeshna umbrosa* in Wyoming; B. Lateral view of the same.

insects such as Hymenoptera, Coleoptera, or Orthoptera. During late July and August, when the streams are low and clear, the trout feed heavily on terrestrial insects such as the orders mentioned above along with Homoptera, occasional larval and adult Lepidoptera, and arachnids.

The rare occurrences of these trout taking adult dragonflies is demonstrated by the fact that these are the only two instances found among the hundreds of trout stomachs examined from this locality. The only other evidence of predation on adult Odonata was the recovery of a single zygopteran wing (Lestidae) from another brook trout. As the actual captures were not witnessed, it is unknown for certain whether the dragonflies were hovering near the stream surface or resting on low foliage or rocks when taken by the fish. Fong (1985) noted that trout will congregate at the shoreline where naiads have moved prior to emerging. As such, the dragonfly prey near the shore may have been teneral adults which were unable to escape the fish. However, these aeshnids develop mainly in shallow ponds (Walker, 1912; Kennedy, 1915; Pennak, 1953), rather than in the primarily lotic environment Rock Creek represents. Other possibilities are that the prey were occupied with mate guarding, territorial defensive activities and/or egg laying, which sometimes occurs underwater (Fincke 1986), and so did not see the trout in time to escape them.

Valley (1993), likewise, reported that rainbow trout in Grande Ronde Lake (Union Co. Ore.) in the Elkhorn Mountains [about 70 mi. (112 km) northeast of John Day in Oregon] seemed to be feeding "exclusively on adult dragonflies" in late July, 1991. Some trout were observed jumping "a foot or more out of water to take ovipositing *Somatochlora* spp.". His wife, Robin, caught some of these rainbows, using an artificial dry fly imitation of a dragonfly, retrieved "fluttering" on the lake's surface. When dissected, the stomachs of these trout contained "only dragonflies, including some aeshnas". Species listed as abundant in Grande Ronde Lake (a small subalpine lake containing lily pads) include *Somatochlora albicincta*, *S. semicircularis* (Selys), *Cordulia shurtleffi* (Scudder), *Libellula quadrimaculata*, *Aeshna palmata* (Hagen), *A. umbrosa*, *A. interrupta*, and *A. juncea* (L.). Valley (1993) also reported that the blue and yellow phases of *A. juncea* were present in about equal numbers, and that "several male *A. interrupta* (were found) in tandem with female *A. juncea*!" at this site.

Finally, W. R. Lamberson (pers. comm.) reported observing a ten in. (25.4 cm) cutthroat trout [*Onchorhynchus clarki lewisi* (Girard)] jumping near the thin end branches of a partly submerged dead tree, apparently catching active (hovering or resting) blue colored damselflies (*Lestes* sp.) near the surface of Klickitat Lake in the Coastal Range of the Cascades (elev. approximately 1220 m) in Lincoln Co., Ore. on a warm sunny afternoon in July, 1981. When caught on a dry fly moments later, this trout's stomach contained either complete specimens or portions of at least five of these damselflies.

Keys used to identify the specimens were: Needham & Westfall (1955), Westfall (1984), and Walker (1958). Common names of the dragonflies are from Borrer (1963) and Paulson & Dunkle (1985 unpubl. ms). Our dragonfly identifications were verified by R. Orr of the USDA, Hyattsville, Md.

ACKNOWLEDGMENTS

We are grateful to A. G. Scarbrough of Towson State University for identifying the robber fly. A. Carter of UMBC dissected and sorted the contents of the trout stomachs. D. Flaim of UMBC and R. L. Orr of the USDA assisted with the identification of the dragonflies. We are grateful to R. Lavigne, P.S.I.S., University of Wyoming for many valuable comments on the manuscript, and for providing specimen data from the University of Wyoming Entomology Collection. O. Flint kindly searched the U.S.N.H.M. collection for Wyoming records of *A. umbrosa*, and corresponded with us regarding this report. We thank W. R. Lamberson, University of Missouri, for the information he provided about trout feeding on damselflies. G. C. Ford, Jr. and R. Gehrman of UMBC developed and printed the photographs from color slides taken by the senior author. F. W. Baldwin and C. L. Wilkens of UMBC prepared the Table.

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